Grants were made to the Committee on Anthropometric Measurements; to the Committee on the Quantitative Study of Biological Variation; to the Committee on the Study of Blind Vertebrates; and to the Committee on Study of the Relation of Plants to Climate. The last two committees were established at this meeting. The one on Blind Vertebrates consists of Mr. Theodore N. Gill (chairman), Messrs. A. S. Packard, C. O. Whitman, S. H. Gage, H. C. Bumpus and C. H. Eigenmann. The one on Relation of Plants to Climate consists of Messrs. Wm. Trelease, D. T. MacDougall and J. M. Coulter.

Resolutions were adopted urging upon the Government of the United States (1) the establishment of a bureau of standards in connection with the U.S. Office of Standard Weights and Measures; (2) the establishment of a Government Reservation in the Primeval Redwood Forest, situated in the Santa Cruz Mountains in California; and (3) the establishment of a Government Reservation in some portion of the hard wood forests of the Southern Appalachian region.

At the meeting of the General Committee held on the evening of the June 28, the city of Denver, Colorado, was chosen as the place for the next meeting, and the time selected was the week ending August 31. The choice of Pittsburg, Pa., as a meeting place in 1902 was recommended by formal resolution.

On the same evening the following officers for the ensuing year were elected:—For President, Prof. Charles Sedgwick Minot, of the Harvard Medical School; for Vice-Presidents, as follows:—Section A, Mathematics and Astronomy, Prof. James MacMahon, of Cornell University; Section B, Physics, Prof. D. T. Brace, of the University of Nebraska; Section C, Chemistry, Prof. John H. Long, of the North-western University; Section D, Mechanical Science and Engineering, Prof. H. S. Jacoby, of Cornell University; Section E, Geology and Geography, Prof. C. R. Van Hise, of the University of Wisconsin; Section F, Zoology, Prof. D. S. Jordan, of Stanford University; Section G, Botany, Mr. B. T. Galloway, of the U.S. Department of Agriculture; Section H, Anthropology, Mr. J. Walter Fewkes, of the Bureau of American Ethnology; Section I, Social and Economic Science, Mr. John Hyde, Statistician, U.S. Department of Agriculture. General Secretary, Prof. Wm. Hallock, Columbia University; Secretary to the Council, Dr. D. T. MacDougall, New York Botanical Gardens.

THE WELLCOME RESEARCH LABORATORIES.

IT is a remarkable sign of the times when the head of a firm principally distinguished for the introduction into this country of American methods of dealing with drugs, *i.e.* by putting them up in new and convenient shapes and doses, goes out of his way to fit up extensive research laboratories. This is what Mr. Wellcome has done. In 1896 laboratories were established in the business premises of the firm in Snow Hill. Now, after four years, during which the work continued to grow, it has been found necessary to give a complete house to the department. A well-built modern house has been secured at No. 6 King Street, Snow Hill, and has been converted into a series of three commodious and well-fitted laboratories, a library and office, and a store-room and workshop-laboratory. Each laboratory is self-contained, and each is connected with the other and with the directors' office by means of telephones. The basement contains a good-sized electric motor, and a dark room for polarimetric and photographic work. Use has been made of the electric mains to heat radiators for the distillation of ether, benzene and other inflammable liquids. The whole is under the direction of Dr. T. B. Power, F.I.C., who has a staff of four assistants, all men who have been carefully selected for their attainments and skill in actual research.

Mr. Wellcome is to be congratulated on his enterprise. His firm, considering the nature of their business, might well have acted on the supposition that research was not strictly within their province. They might have argued, "Research is the business of the drug manufacturer and the manufacturing chemist; it does not concern the compounder of medicines." Their success in former years is a solid argument in favour of such a view, which can be very easily strengthened by a consideration of the success of many firms who have pursued an exactly similar line of business.

Mr. Wellcome intends to carry on his laboratories in no narrow spirit; this means, I presume, that he has other views than the conversion of his business into a chemical manufacturing concern. Though much work is done towards the perfection of the firm's preparations, time has been found for several researches which have been published, and other work of this kind is in hand. At present the bulk of the work is carried out on the natural drugs, very little having been undertaken in the direction of investigations leading to the discovery or further knowledge of the properties of artificial medicinal substances. There is undoubtedly a vast field in the direction so far pursued, but every one must hope that the other will not be neglected, and that at length this country may make a contribution to the number of substances of medicinal value derived directly and not through the medium of plant or other life from the carbon compounds of the aromatic series.

The laboratories were informally opened on June 18, when at Mr. Wellcome's invitation a number of gentlemen interested in science, together with some representatives of the Press, were received by Dr. Power and conducted over the building. All interested in the advance of chemistry, whether pure or applied, will wish Mr. Wellcome success, and also that he may find imitators among the numbers of firms who are meditating an advance in the direction of a more scientific method of conducting their manufactures. R. J. FRISWELL.

NOTES.

IN the House of Commons on Tuesday, Mr. Goschen announced that a committee of experts would be appointed to inquire into the efficiency of water-tube boilers in actual operation in different types of ships of H.M. Navy.

THE Additional Estimate for the Navy for the year 1900–1901 includes 9500*l.* for wireless telegraphy apparatus; 3600*l.* for telescopic sights for quick-firing guns; and 16,500*l.* for gyroscopes for Whitehead torpedoes.

THE scientific congresses to be opened in connection with the Paris Exposition during the present month are:—July 19–25, applied mechanics; July 23–28, applied chemistry; July 19–21, naval architecture and construction; July 28–August 3, navigation; July 28–August 4, chronometry; July 23–28, photography; July 18–21, homœopathy; July 23–28, professional medicine; July 27–29, medical press; July 27–August 1, electrology and medical radiology.

WE have been notified that the title of the subject for discussion at the joint meetings of the Institution of Electrical Engineers and the American Institute of Electrical Engineers to be held in the American Pavilion in the Paris Exhibition on the morning of Thursday, August 16, is "The relative advantages of alternate and continuous current for a general supply of electricity, especially with regard to interference with other interests." We understand it is specially desired to discuss how

far interference with other undertakings, rather than ordinary commercial and industrial conditions, will come to be a determining factor in the selection between continuous and alternating currents. It is expected that many members of the American Institute will spend a few days in London on their way to the joint meeting in Paris. Arrangements are being made to entertain the visitors, and it is hoped that a large number of the British members will assist in making the visit a memorable one.

A CIRCULAR-LETTER has, this week, been addressed to the students of the Institution of Electrical Engineers informing them that the Council of the Institution propose to grant 5*l.* to each of twenty selected students to assist them to visit the electrical exhibits in the Paris Exhibition. Intending candidates must send in their applications by Saturday, July 28. In the selection, the Council will give preference, other things being equal, to those who, being still students of the Institution, have either, or both, read papers before the students' section, or been members of the committee of that section.

THE Paris Société d'Encouragement has awarded the following medal and prizes:—Gold medal to M. Potier for his work in physics; 2000 francs to M. Codron for his works on machine tools; 2000 francs to MM. Charabot Dupont and Pilet for their work on essential oils; 500 francs to M. Halphen for his work on the analysis of fatty bodies, and to M. Blanc for his work on the constitution of camphor; 500 francs to M. Granger for his study of the application of tungsten blue to ceramics; and 1000 francs to MM. Coudon and Boussard for their study of the potato.

THE Paris correspondent of the *Chemist and Druggist* announces that the late M. Milne-Edwards, director of the Paris Museum of Natural History and professor of zoology at the Paris School of Pharmacy, has bequeathed his scientific library, which is exceptionally complete and valuable, to the Paris Museum. The books are to be sold, and the proceeds will be applied towards maintaining the professorship of zoology, which the deceased *savant* occupied with so much distinction. M. Milne-Edwards also bequeathed 20,000 francs to the Paris Geographical Society, of which he was president, and 10,000 francs to the Société des Amis des Sciences.

FOR several days in last week the weather was very warm over a large part of England, and in London the temperature frequently exceeded 80°. This week the temperature has still further increased, and on Monday the thermometer in the screen registered 94° at Greenwich, which is the highest reading in July since 1881, and is higher than in any summer since 1893, while in all there have only been seven days during the last sixty years with so high a temperature there. At Camden Town the shade temperature registered 95°·2, the highest reading there since 1858. Thunderstorms developed at the beginning of the week over a large part of the country, but no appreciable amount of rain has fallen in London for about a fortnight.

WE learn from *Science* that it is proposed to celebrate the 70th birthday of Prof. Wilhelm Wundt, which will occur on August 16, 1902, by the publication of a "Festschrift," to which his former students are invited to contribute. The manuscripts must be forwarded to Prof. Külpe, Würzburg, not later than January 1, 1902.

IT was recently stated in the public press that postal packets containing plants for transmission to England were refused at Swiss post-offices on the ground that the plants would not be permitted to enter England. The Board of Customs has, however, just stated that there is no objection to the importation of plants from Switzerland, if they are sent by parcel post or letter post. But plants must not be sent by sample post, and the refusal of packets presented for transmission as samples appears to have produced the impression that the importation of flowers is not allowed.

AN exhibition and conference and other meetings will be held at the Crystal Palace, Sydenham, on July 20 and 21, in celebration of the bicentenary of the introduction of the sweet pea to Britain from Sicily in 1700. Some authorities hold that two forms, having a general relationship one to the other, were introduced, one from Sicily and the other from Ceylon. The history of the sweet pea and its earlier development will be dealt with at the conference meetings which are to be held in connection with the celebration. Many foreign horticulturists are giving the celebration their support in various ways; and one of the papers at the conference will deal with the culture and development of the sweet pea in the United States, where many fine varieties have been cultivated.

THE *Times* states that the construction of the vessel designed by Mr. W. E. Smith, one of the chief constructors to the Admiralty, for the National Antarctic Expedition, is now in active progress at the yard of the Dundee Shipbuilders' Company. The ship, which is to be named the *Discovery*, is to be barque-rigged and to have three decks. Accommodation for those on board will be provided under the upper deck. The stem will be of the ice breaker type, with strong fortifications. The length of the vessel between perpendiculars is 172 feet; beam, 34 feet, and depth, 19 feet. The timbers are of oak dowelled and bolted together, and the keel, deadwoods, the stem, and the stem-posts are also of oak. The planking is of American elm and pitch pine, and the inside beams are of oak. With the object of avoiding the magnetic influence of iron on the scientific instruments on board, it has been decided that for a considerable radius amidships the knees and fastenings shall be of naval brass. In case the *Discovery* should have to winter in the ice, a heavy waggon cloth awning of strong woollen felt is to be provided. The fittings and equipment of the vessel will be of the most modern type. The engines, which are to indicate 450-horse-power, are to be constructed by Messrs. Gourlay Brothers and Co., Dundee.

NEWS has just reached this country of the death of a well-known geologist, Prof. G. H. F. Ulrich, F.G.S., who, since 1878, held the position of director of the School of Mines connected with the Otago University, New Zealand. Prof. Ulrich fell from a cliff while gathering rock specimens at Port Chalmers, and the injuries he received terminated fatally. Prof. Ulrich was born at Clausthal-Zillerfeld, Germany, in 1830, and was educated in his native town at the High School, and subsequently graduated at the Royal School of Mines, Clausthal, Hartz. He went to Forest Creek, Victoria, in 1854, and was appointed in 1857 assistant secretary and draughtsman to the Royal Mining Commission in Victoria. He was afterwards appointed assistant field geologist under Mr. Selwyn in the Geological department of Victoria. He continued an officer of the Geological Survey department until its abolition in 1869, when he became curator of the mining section under Mr. Newbery, superintendent of the industrial and technological museum and lecturer in mining at the University of Melbourne. He was appointed by the South Australian Government to report on their copper mines and goldfields, and in 1875 he paid his first visit to New Zealand and reported on the Otago goldfields. In 1877, the Otago University Council having decided to institute a school of mines, the Chancellor secured the services of Prof. Ulrich for the Otago University. The School of Mines was for some years small, and not very

fully equipped, but in 1887 additional lecturers were appointed, and as the advantages of the course came to be appreciated, the number of students increased rapidly, and the attendance is now very large. Through the energy of Prof. Ulrich the models and appliances which had been procured from time to time became a valuable collection, especially in the mineral department, to which he was constantly adding from his own private collections of minerals and stones.

THE Committee on Indexing Chemical Literature presented their report of progress at the recent meeting of the American Association. From it we learn that Dr. Alfred Tuckerman has completed and sent to the Smithsonian Institution a supplement to his index to the literature of the spectroscope, which covers the period from 1887 to 1899. Dr. H. Carrington Bolton's second supplement to his select bibliography of chemistry, containing a list of 7500 chemical dissertations, is passing through the press; it will form a volume of the Smithsonian Miscellaneous Collections. Mr. A. G. Smith, of Cornell University, is engaged on an index to the literature of selenium and tellurium, which, it is expected, will be completed this summer. Dr. Frank I. Shepherd proposes to make a bibliography of the alkaloids. Mr. Frank R. Fraprie contemplates preparing an index to the literature of lithium.

IN the *Revue Générale des Sciences*, M. Louis Olivier gives some further particulars of Poulsen's "telegraphone," which is attracting attention at the Paris Exhibition. He describes several devices for increasing the volume of sound, or "intensifying" the record, to use the language of the photographer. The steel band with the consequent poles, which forms the original record, is made to pass between the poles of an electromagnet, which transfers the record to another band. This may be done several times over, and the record taken simultaneously from all the bands. In another arrangement the record is intensified by passing it very rapidly through the second magnetic field, which, as we know, has the effect of increasing the induced currents, and therefore also the intensity of the secondary record.

A NOVEL type of Newton's rings is described by Mr. A. C. Longden in the current number of the *American Journal of Science*. They are prepared by exposing a glass plate to the kathode rays emitted from a small globule of selenium. The film thus deposited is thickest at the point exactly opposite the globule, and tapers off towards the sides. The result is a film in the shape of a very flat lens, the upper and lower surfaces of which reflect light somewhat in the same manner as the upper and lower surfaces of the air film in Newton's device, with the difference, however, that in Mr. Longden's arrangement the film tapers outward instead of inward. Hence the rings increase in breadth and brilliancy away from the centre, and the order of the colours is reversed. The effect is described as very pretty.

THE annual list of the staffs of the Royal Gardens, Kew, and of botanical departments and establishments at home, and in India and the Colonies, in correspondence with Kew, has just been issued as an appendix to the *Bulletin of Miscellaneous Information*. We notice that sixty-six of the officers of the various botanic gardens have been trained at Kew, and seventeen others were appointed on the recommendation of the director of the Royal Gardens. With so many efficient observers distributed over our possessions it is not surprising that Kew is able to be of great service to the Empire as well as to science.

PLAGUE has now been established in Sydney for several months, and in an address delivered before the New South Wales Branch of the British Medical Association, Dr. Frank Tidswell of Sydney recently discussed a variety of interesting questions relating to the disease. Referring to his remarks on rats, the *Lancet* points out that there are instances which show that the presence of a plague-rat is often responsible for the illness in man. For example, a number of dead rats found one morning in a cotton factory at Bombay were removed by twenty coolies. Within the three following days about half of them fell sick with plague, whilst those in the store who had not touched the rats were not affected. Again, the coachman of an English family in Bombay found a dead rat in a stable and removed it. Three days later he fell sick with plague and died in a few hours, no other person in the same house being affected. Many persons, however, have caught plague without handling plague rats, and many persons have handled plague rats without catching plague. To explain this difficulty Simond has suggested that the infection is carried by the fleas natural to the rats. Perfectly healthy rats harbour very few fleas, and are very expert in removing them, but fleas are abundant on sick rats. After death, as the body becomes cold, the fleas leave it. In this way Simond accounted for the fact that a plague rat may be handled with impunity some hours after death. If the fleas from the dead rat reach another rat or a human being, they may inoculate the bacilli they acquired by ingesting the blood of their former host. In some of Simond's experiments sick and healthy rats in separate cages were enclosed in a glass jar, and it was found that when no fleas were present the healthy animals did not become infected.

COLOUR photometry is a subject that Sir William Abney has made his own, and in his last communication to the Royal Society he describes a method of estimating the luminosity of coloured surfaces that is especially applicable when the source of light is a large surface, such as the sky. In "Colour Photometry, Part iii." it was shown that only one ray of the spectrum, a greenish-yellow, progressed in luminosity at the same rate as white light. If, for example, red, greenish-yellow, blue and white lights are made of equal luminosity, and the illuminating beams are simultaneously and equally reduced in intensity, the luminosity of the red will diminish the most rapidly, that of the blue the least rapidly, the other two remaining equal. Moreover, the colour disappears more quickly than the luminosity (except in the case of pure red), tending towards greyness, so that colours of feeble luminosity are more easy to match than bright colours. The new method of colour photometry is based upon these facts. By means of concentric rotating discs, which are, when necessary, slit radially and interlaced, the proportion of black and white that matches first a green and then a yellow disc is determined. The comparisons are facilitated by observing the rotating discs through a "black transparent medium," such as an unstained developed photographic film, which may be so dense that the colour practically disappears, giving place to a dull grey. The value of a red disc is ascertained by interlacing it with the green and blue discs to produce a grey, which is then matched with the black and white. Thus, having three standard colours of known values, the luminosity of any other colour can be ascertained by substituting a disc of it for one of the standard colours to produce a grey, and matching the grey as before. The results given by this method agree closely with those obtained by the method previously described by the author. Sir William Abney has in this way determined the luminosities of various coloured surfaces and calculated the amount of black necessary for each, so that they shall be reduced to equal luminosity. He has then prepared a disc divided into several annuluses, each partly coloured and partly black, so that when rotated the whole appears of equal luminosity when illuminated by the light for which it is calculated. By the selection of suitable colours such a disc is a very convenient and effective test for any defect in either the colour sensitiveness of a photographic plate, or in the coloured screen used to compensate its inherent deficiencies in this matter. For the rotating disc, which is equally luminous throughout, will give, when the

negative is developed, an image of equal density throughout, if the sensitive plate and colour screen are properly adjusted to each other.

THE U.S. Weather Bureau has published a *Bulletin* (No. 29), entitled "Frost fighting," by Mr. A. G. McAdie. A bulletin on the same subject was recently issued by the Bureau, but it is believed that the more recent experiments made in California are sufficiently valuable to extensive fruit interests to justify this second publication, and that the loss due to frosts in that State, hitherto considered unavoidable, can be prevented. The problem is of a two-fold nature: accurate forecasting of the frost period, and efficient methods of raising the temperature at critical times. The various protective methods, based on irrigation, the production of cloud or fog, and devices for screening the fruit trees are photographically illustrated. Of all the methods proposed, with the exception of the use of wire screens, irrigation has the largest amount of evidence in its favour; hot water from a boiler is forced through a number of furrows, and the temperature of the air is heated by the rising of the water-vapour.

WE have received from the Rev. W. Sidgreaves a copy of the results of meteorological and magnetical observations at Stonyhurst College Observatory, near Blackburn, for the year 1899. This observatory is fully equipped with self-recording instruments, and has for many years published valuable observations both independently and in connection with the Meteorological Office. During the past year a special report of hourly rainfall from 1891 to 1898 was prepared for that office. Much attention is given to solar observations and to the connection of sun-spots with terrestrial phenomena. The movements of the upper clouds, and the determination of the magnetic elements, also occupy the special attention of the small available staff of the observatory. An appendix contains observations taken at St. Ignatius College, Malta.

IN a paper on malformed specimens of the common pond-mussel, published in the last issue of the *Journal of Malacology*, Mr. H. H. Bloomer shows that in certain instances this mollusc is able to repair severe injuries to the mantle-lobes, but cannot make good damage inflicted on the gills.

DR. H. L. BRUNER communicates to vol. xvi. No. 2 of the *Journal of Morphology* the results of observations on the hearts of lungless salamanders, in which it is shown that with the lungs disappears also the septum between the auricles of the heart. Since, however, the normal circulation is not yet fully understood, it would be premature to discuss the reason for this loss.

IN the June issue of the *American Naturalist*, Miss Rathbun continues her invaluable illustrated synopsis of North American invertebrates, dealing in this section with certain groups of crabs. It may be hoped that, when complete, this synopsis will be reissued in book-form.

THE phylogeny of the butterflies of the family Pieridæ (best known by the ordinary British "whites") is discussed by Mr. A. R. Grote in No. 161 of the *Proceedings* of the American Philosophical Society. The author is of opinion that the family is an offshoot from the Hesperiidæ, or skippers, which is itself related to the Nymphalidæ, and that the "blues" may likewise be another offshoot from the same stock. From the scant evidence afforded by fossil forms, it further seems evident that the blues and the whites are modern types of butterflies, while the skippers and the nymphalids are of greater antiquity.—Anthropologists will find considerable interest in a paper on the divisions of the South Australian Aborigines, by Mr. R. H. Mathews, which appears in the same serial.

IN a paper published in the *Comunicaciones* of the Buenos Aires Museum (vol. i. No. 6) Dr. F. Ameghino describes and figures certain mammalian remains from the areniscan formation of southern Patagonia. These remains are stated to be found in association with those of dinosaurs as well as of fishes of the genera Synechodus, Lepidotus and Ceratodus, and the formation is accordingly correlated with the lower Cretaceous of Europe and the United States. The mammalian remains are, however, of such a highly specialised type that it is almost impossible to believe they can be of such great antiquity; and it seems probable that some other explanation of their alleged association with Cretaceous types will have to be found.

WE learn from the *American Naturalist* that a school of applied agriculture and horticulture will be established near New York City, to open in September, for study and practical training. Students will have the use of the laboratories and of the extensive collection of plants in the museum and conservatories and in the grounds of the New York Botanic Garden. The work will be under the direction of Mr. George T. Powell.

THE following facilities for the practical study of biology during the summer vacation are offered in the United States, in addition to those already announced. The Biological Laboratory of the Brooklyn Institute of Arts and Sciences at Cold Spring Harbour, Long Island, will be open from July 1 to August 25, under the guidance of Prof. Davenport. The Lake Laboratory of the Ohio State University at Sandusky, Lake Erie, will be open for eight weeks from July 2. Four courses of lectures will be given in zoology, and three in botany. The Rhode Island summer school for nature study is holding its session at Kingston, R.I., from July 5 to 20. Beloit College, Wisconsin, will hold a summer school on Madeline Island, Lake Superior, from July 26 to Aug. 30. The natural science camp for boys will hold its eleventh session at Canandaigua, N.Y., under the management of Mr. Albert L. Arey. Instruction will be given in biology, entomology, taxidermy, and photography.

THE *Biologisches Centralblatt* for June 15 and July 1 contains a detailed biography of the late eminent diatomist, Comte Abbé F. Castracane, together with a complete bibliography of his very numerous contributions to botanical literature.

Bulletin No. 10 (February 1900) of the Michigan State Agricultural College Experiment Station (Agricultural Department), is devoted entirely to investigations in the cultivation of the sugar-beet, by Mr. J. D. Towar, chiefly in relation to the advantages of different soils and manures.

PROF. L. ERRERA reprints from the *Revue de l'Université de Bruxelles* a paper on spontaneous generation, one of a series of essays on botanical philosophy. After a historical account of the controversy, he sums up thus:—"Si donc la génération spontanée est encore irréalisée dans nos laboratoires, rien ne prouve qu'elle soit à jamais irréalisable."

WE have received the *Transactions* of the British Mycological Society for the season 1898–1899. It contains the address of the President, Dr. C. B. Plowright, on the recent additions to our knowledge of the Uredineæ and Ustilagineæ, with special reference to British species, a report of the New Forest fungus foray, and five papers on new or rare fungi.

THE economic geology of the United States is very amply dealt with in the larger reports of the Geological Survey, while individual States publish reports on particular subjects. One of these on the clays of Alabama, by Dr. E. A. Smith and Dr. H. Ries, has just reached us. The State yields china clay, fire clay, pottery clay, and brick clay, all of which are very fully described with regard to their characters, geological age and distribution, and a number of analyses are given. In addition to the local account, there is also a general discussion of clays, their chemical, physical and mineral characters, such as will be of great use to any

one studying the subject from a scientific as well as economic point of view. Mention is made of beds of white pulverulent silica, which when mixed with clay has been used in the manufacture of a paint.

WE have received from the Geological Survey of Canada, Part I of a "Catalogue of Canadian Birds," by Mr. J. Macoren, dealing with water-birds, gallinaceous birds, and pigeons.

THE third volume of Prof. G. O. Sars's "Account of the Crustacea of Norway," dealing with the anomalous group Cumacea, is in course of publication by the Bergen Museum. Parts v. and vi., devoted to the Diastylidæ, have just been issued.

PART 10 of Memoir III. of the Australian Museum, Sydney, on "The Atoll of Funafuti" has now been issued. It is the concluding part of the memoir, and contains lists of the contributors and plates, and an index to the whole work.

MESSRS. ISENTHAL AND CO., have issued a revised edition of their list of apparatus and accessories for work with Röntgen rays. Particular attention is given by this firm to the design and construction of instruments for radiographic work, and any one contemplating an installation for this purpose will find the list just issued well worth examination.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*, ♀) from West Africa, presented by Mr. W. B. Davidson Houston; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Mrs. Heigham; a Common Marmoset (*Hapale jacchus*) from South-east Brazil, presented by Mrs. Alexander Grant; two Grey-headed Love-Birds (*Agapornis cana*) from Madagascar, presented by Mrs. Harry Blades; a Cuckoo (*Cuculus canorus*), European, presented by Mr. L. W. Wiglesworth; an Entellus Monkey (*Semnopithecus entellus*, ♀) from India, a —— Bear (*Ursus*, sp. inc.) from Kuldja, a Himalayan Snow Partridge (*Tetrogallus himalayensis*) from the Himalayas, two Brazilian Tortoises (*Testudo tabulata*) from South America, deposited; a Sharp-nosed Badger (*Meles leptorhynchus*) from China, a Rough Fox (*Canis rudis*) from South America, purchased; a Little Bittern (*Ardetta minuta*), European, received in exchange; a Brindled Gnu (*Connochoetes taurina*, ♀), an Altai Deer (*Cervus eustephanus*), born in the Gardens.

RHYTHMS AND GEOLOGIC TIME.[1]

THE subject to which I shall invite your attention this evening is by no means novel, but might better be called perennial or recurrent; for the problem of our earth's age seems to bear repeated solution without loss of vigour or prestige. It has been a marked favourite, moreover, with presidents and vice-presidents, retiring or otherwise, when called upon to address assemblies whose fields of scientific interest are somewhat diverse—for the reason, I imagine, that while the specialist claims the problem as his peculiar theme of study, he feels that other denizens of the planet in question may not lack interest in the early lore of their estate.

The difficulty of the problem inheres in the fact that it not only transcends direct observation but demands the extrapolation or extension of familiar physical laws and processes far beyond the ordinary range of qualifying conditions. From whatever side it is approached the way must be paved by postulates, and the resulting views are so discrepant that impartial onlookers have come to be suspicious of these convenient and inviting stepping stones.

In giving brief consideration to each of the more important ways by which the problem of the earth's age has been approached, I shall mention first those which follow the action of some continuous process, and afterward those which depend on the recognition of rhythms.

The earliest computations of geologic time, as well as the majority of all such computations, have followed the line of the most familiar and fundamental of geological processes. All through the ages the rains, the rivers and the waves have been eating away the land, and the product of their gnawing has been received by the sea and spread out in layers of sediment. These layers have been hardened into rocky strata, and from time to time portions have been upraised and made part of the land. The record they contain makes the chief part of geologic history, and the groups into which they are divided correspond to the ages and periods of that history. In order to make use of these old sediments as measures of time, it is necessary to know either their thickness or their volume, and also the rate at which they were laid down. As the actual process of sedimentation is concealed from view, advantage is taken of the fact that the whole quantity deposited in a year is exactly equalled by the whole quantity washed from the land in the same time, and measurements and estimates are made of the amounts brought to the sea by rivers and torn from the cliffs of the shore by waves. After an estimate has been obtained of the total annual sedimentation at the present time, it is necessary to assume either that the average rate in past ages has been the same or that it has differed in some definite way.

At this point the course of procedure divides. The computer may consider the aggregate amount of the sedimentary rocks, irrespective of their subdivisions, or he may consider the thicknesses of the various groups as exhibited in different localities. If he views the rocks collectively, as a total to be divided by the annual increment, his estimate of the total is founded primarily on direct measurements made at many places on the continents, but to the result of such measurements he must add a postulated amount for the rocks concealed by the ocean, and another postulated amount for the material which has been eroded from the land and deposited in the sea more than once.

If, on the other hand, he views each group of rocks by itself, and takes account of its thickness at some locality where it is well displayed, he must acquire in some way definite conceptions of the rates at which its component layers of sand, clay and limy mud were accumulated, or else he must postulate that its average rate of accretion bore some definite ratio to the present average rate of sedimentation for the whole ocean. This course is, on the whole, more difficult than the other, but it has yielded certain preliminary factors in which considerable confidence is felt. Whatever may have been the absolute rate of rock building in each locality, it is believed that a group of strata which exhibits great thickness in many places must represent more time than a group of similar strata which is everywhere thin, and that clays and marls, settling in quiet waters are likely to represent, foot for foot, greater amounts of time than the coarser sediments gathered by strong currents; and studying the formations with regard to both thickness and texture, geologists have made out what are called *time ratios*—series of numbers expressing the relative lengths of the different ages, periods and epochs. Such estimates of ratios, when made by different persons, are found to vary much less than do the estimates of absolute time, and they will serve an excellent purpose whenever a satisfactory determination shall have been made of the duration of any one period.

Reade has varied the sedimentary method by restricting attention to the limestones, which have the peculiarity that their material is carried from the land in solution; and it is a point in favour of this procedure that the dissolved burdens of rivers are more easily measured than their burdens of clay and sand.

An independent system of time ratios has been founded on the principle of the evolution of life. Not all formations are equally supplied with fossils, but some of them contain voluminous records of contemporary life; and when account is taken of the amount of change from each full record to the next, the steps of the series are found to be unequal in magnitude. Though there is no method of precisely measuring the steps, even in a comparative way, it has yet been found possible to make approximate estimates, and these in the main lend support to the time ratios founded on sedimentation. They bring aid also at a point where the sedimentary data are weak, for the earliest formations are hard to classify and measure. It is true that these same formations are almost barren of fossils, but biological inference does not therefore stop. The oldest known fauna,

[1] Abridged from an address to the American Association for the Advancement of Science, at New York, June 26, by the retiring President, Mr. G. K. Gilbert. By the courtesy of the Editor of *Science*, advance proofs of the address were received.